SULPHUR RECOVERY GUIDELINES REVIEW

ADVISORY GROUP REPORT

APRIL 2000

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1 SUMMARY OF RECOMMENDATIONS

These recommendations are the consensus agreement of the Advisory Group.

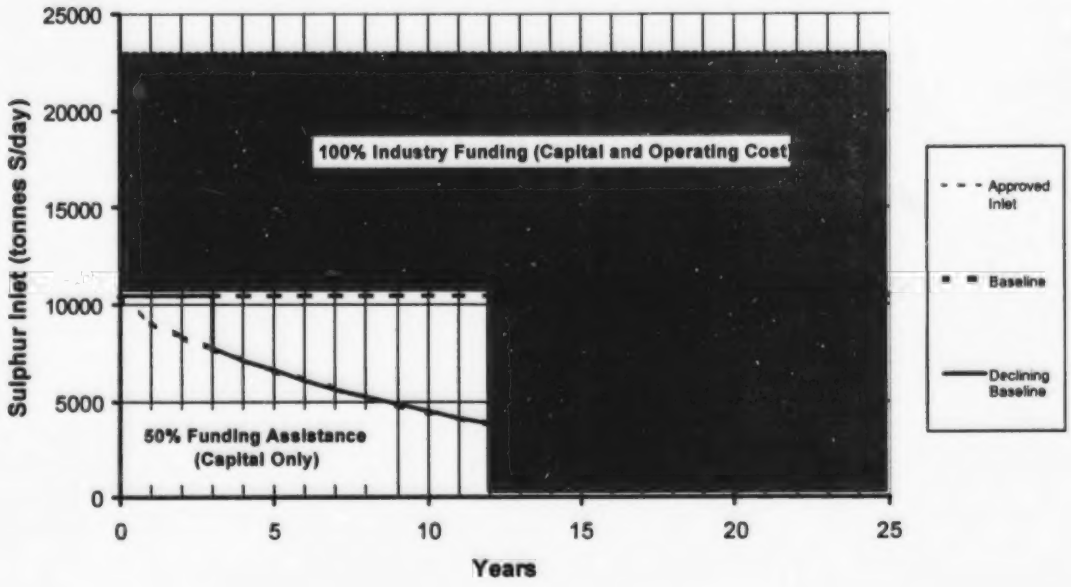
1.1 Proposal for Degrandfathering of Gas Plants

The following proposal was developed as a consensus agreement by the Advisory Group. It is put forward as a package, and the consensus support of group members is based upon all elements being accepted in their entirety.

- All sour gas plants should be degrandfathered, in accordance with a 7.5% decline from the 1999 base year sulphur inlet rates. All sulphur inlet above this decline line would have to meet IL 88-13 sulphur recovery requirements.
- A three-year period should be allowed for initial compliance, and any grandfathered capacity remaining after 20 years should be terminated.
- An incentive for higher recovery should be provided by banking of credits (tonnes of sulphur) for higher than required recovery. Subsequent use of these credits when recovery is below requirement would be available on a 0.5 % per quarter basis.
- A method of royalty reductions should be provided for fifty percent of the capital cost of facility upgrades that would be necessary under degrandfathering. Access to this financial assistance should be limited to a time period of 12 years, and to capacity upgrades up to the 1999 base-year sulphur inlet.

This proposal is depicted graphically in Figure 1 : Degrandfathering Proposal

Figure 1 : Degrandfathering Proposal



Independent of the package proposal, it is recommended that a process should be in place for the following:

- Applications for exemption from degrandfathering chould be considered on an individual plant basis,
- Applications for relief based on acid gas quality could be considered on an individual plant basis,
- Applications for trading of emissions among plants in close proximity could be considered.

1.2 Regulatory Process for Degrandfathering

The regulatory processes of the Alberta Energy and Utilities Board (EUB) and Alberta Environment (AENV) should be streamlined for applications that would have to be made to comply with degrandfathering requirements.

1.3 Incentives for Higher Recovery for Non-Grandfathered Gas Plants

The incentives for higher recovery proposed above for grandfathered gas plants and in the following for heavy oil upgraders and oil refineries, should be applied universally to all facilities subject to IL 88-13.

1.4 Heavy Oil Upgraders, Oil Refineries and Other Industrial Facilities

The application of the basic requirements of IL 88-13 Sulphur Recovery Guidelines should be extended to apply to heavy oil upgraders, oil refineries, and other industrial facilities. Some additional specific criteria recommended to apply to these facilities are:

- The guidelines should apply to acid gas streams from amine units and sour water strippers.
- An allowance additional to the 0.3% in IL 88-13 should be provided for plant maintenance. A bankable allowance of 0.15% in one quarter per year should be provided, which can be used or carried forward up to five years.
- The same incentive system for higher than required recovery that was recommended above for gas plants should be provided.
- When an existing plant is expanded, the whole plant should be subject to a higher recovery as specified in IL 88-13 for a plant of that total capacity.
- Allowances for the effect of acid gas quality on sulphur recovery capabilities could be considered in individual plant applications.

1.5 Other Upstream Petroleum Facilities

The application of the basic requirements of IL 88-13 Sulphur Recovery Guidelines should be extended to apply to other upstream petroleum facilities such as oil and gas batteries and compressor stations. Additional specific criteria can be applied to these categories of facilities.

1.6 Plant Proliferation Measures

No additional basic regulations are required for gas plant proliferation. However, the Advisory Group agreed that it is essential that existing regulations need to be more diligently followed by industry and enforced by the EUB and AENV. The objective is to make the best possible decisions regarding gas processing facilities including ensuring that all social, environmental, and economic factors are evaluated in a thorough, credible, and transparent manner. To facilitate this, the following measures are proposed:

- A decision tree to provide a framework for evaluation and decision making in gas facilities applications
- No new gas processing facilities be permitted within a 15 kilometer radius of an existing facility capable of processing the proposed gas, unless the proponent can show that significant social or environmental net benefit would result
- Development of a mediation/arbitration procedure to resolve economic concerns

1.7 Structure of Sulphur Recovery Regulations

Sulphur recovery requirements for all upstream and downstream petroleum facilities in Alberta should be incorporated in one guideline. This would include common criteria applicable to all facilities and additional criteria applicable to specific categories of facilities.

1.8 Period of Application of Recovery Requirements

The sulphur recovery guidelines should be applied as a calendar quarterly requirement only. The calendar quarterly requirement is 0.3% less than the design or normal operating requirement specified in IL 88-13.

1.9 Enforcement of Sulphur Recovery Guidelines

Enforcement of sulphur recovery requirements with steps of escalating consequences, as currently employed by the EUB, is supported. The need for consistent and continuing enforcement is emphasized.

2 BACKGROUND

The current sulphur recovery guidelines in effect for sour gas plants in Alberta were issued in August 1988, by the Alberta Energy and Utilities Board (EUB) and Alberta Environment (AENV), in Informational Letter IL 88-13.

IL 88-13 increased the level of sulphur recovery requirements, but plants existing at that time did not have to meet the new requirements. The recovery levels of these grandfathered plants were however subject to revision. If capacity expansions of greater than 25 percent were made, and if new gas was connected with the equivalent of an 8 to10 year life, upgrade to new plant standards was required. Expansions and new gas connections less than the above, could still result in some upgrade being required, although not necessarily to the full new plant requirement. Plant requirements could be upgraded based on a review of their performance history. All situations would be considered on a case by case basis. In all cases, local community input would be considered.

In practice, the above criteria were found to be difficult to apply, particularly the connection of new gas. The lives of grandfathered plants have turned out to be longer than anticipated. Industry circumstances have changed, particularly the level of gas prices and level of exploration and development. Increasing community concern has resulted in lengthy negotiations and hearings in some cases.

The IL 88-13 Sulphur Recovery Guidelines were developed for sour gas processing plants, and the guidelines refer only to these facilities. However, the guidelines have since been used in setting requirements for upstream petroleum facilities other than gas plants, and for oil refineries and heavy oil upgrader plants.

The IL 88-13 guidelines exempt plants with less than one tonne per day of sulphur throughput from having to recover sulphur. There is a concern that plants may be intentionally sized below this limit to avoid the requirement of sulphur recovery, resulting in a proliferation of plants.

3 SULPHUR RECOVERY GUIDELINES REVIEW PROCESS

In GB 99-10 dated May 20, 1999, the EUB advised that it would conduct a review of certain elements of the IL 88-13 Sulphur Recovery Guidelines. The objectives were to update and/or clarify:

- sulphur recovery requirements for grandfathered sour gas plants,
- application of the sulphur recovery guidelines to other facilities, and
- small gas plant proliferation guidelines.

The review was confined to issues of application of the sulphur recovery requirements, and excluded a review of the basic sulphur recovery requirement values in IL 88-13.

A discussion paper by EUB staff (GB 99-17) was issued on September 28, 1999 to assist stakeholders in providing input. The above issues were discussed and possible solution alternatives were presented.

A multi-stakeholder public advisory group (the Advisory Group) was formed to assess various options available, and relative costs and benefits. The Advisory Group is described in the following section.

Responses from the public were requested by December 15, 1999. The EUB and AENV will consider the input received from the public and the input received from the Advisory Group in this report, in deciding changes to be made.

4 ADVISORY GROUP

The Sulphur Recovery Guidelines Review Advisory Group was established by the EUB in September 1999. It is comprised of ten members, including individuals from the environment area, industry, technical and academic areas, and the public. The members and their backgrounds are listed in Table 3 : Sulphur Recovery Guidelines Review Advisory Group Members.

The Advisory Group was assisted by a third-party facilitator. The EUB provided support services and consultation, but the Group's deliberations and recommendations were made independently from the EUB and AENV.

The Group first convened on October 29, 1999, and met a total of eleven times, concluding on March 30, 2000.

5 TERMS OF REFERENCE AND ISSUES ADDRESSED

At the outset, the Advisory Group reflected on the larger picture of acidifying emissions in the Province of Alberta, other contaminants being emitted to the atmosphere, and other organizations involved in air emission policies. In particular, the Group reviewed the involvement and initiatives of the Clean Air Strategic Alliance in regard to acidifying emissions to the atmosphere. There was concern about the Group producing a narrowly focused result that might be inconsistent with broader views and initiatives.

While the Group contemplated the need for considering issues and terms of reference beyond those in the EUB Discussion Paper, the Group ultimately decided to confine itself to those in the EUB Discussion Paper, which are as follows:

Issues

- Clarify sulphur recovery requirements for grandfathered gas plants
- Clarify the application of sulphur recovery guidelines to other facilities
  - Upstream petroleum industry
  - Industrial facilities and downstream petroleum industry
- Clarify proliferation guidelines for small gas plants
- Application and enforcement of sulphur recovery guidelines
  - Annual and quarterly requirements
  - Enforcement

Guiding Principles

- The sulphur recovery guidelines will be clearly defined, easily understood and consistently applied.
- The application of the sulphur recovery guidelines will balance consideration of the potential public and environmental benefits with potential costs, including impacts on resource recovery.
- The application of sulphur recovery guidelines will be based on precautionary principles.

6 GRANDFATHERED GAS PLANTS – FACTORS CONSIDERED

6.1 Background

There are 34 grandfathered sulphur recovery plants and 28 grandfathered acid gas flaring plants currently in operation. These are listed in tables in Appendix 1: Cost of Degrandfathering.

6.2 Principle of Grandfathering

The Advisory Group considered whether there were any general principles with respect to the practice of grandfathering. However, the Group did not reach a consensus on any generic principles.

In their 1988 decision to grandfather existing plants, the EUB and AENV indicated that grandfathering should depend on plants' remaining lives. They defined some criteria and performance reviews that would result in upgrades being required. While these criteria and reviews proved to be difficult to apply on a practical basis, they did indicate the intent that grandfathering should not extend indefinitely.

6.3 Sulphur Emission Reductions from Degrandfathering

The Advisory Group made estimates of the potential reduction in emissions that could result if degrandfathering sour gas plants had to meet IL 88-13 requirements.

The reduction would be 455 tonnes per day if compared to maximum licensed rates, reflecting a case where all plants were able to be filled to capacity. The reduction would be 91 tonnes per day if compared to 1998 actual emissions because plants in aggregate are not fully utilized at the current time.

Table 1 : Sulphur Emission Reductions from Degrandfathering

	Grandfathered Sulphur Recovery Plants	Grandfathered Acid Gas Flaring Plants	All Grandfathered Plants
Emissions at Maximum Licensed Throughput	495	90	585
Actual Emissions in 1998	176	45	221

	Grandfathered Sulphur Recovery Plants	Grandfathered Acid Gas Flaring Plants	All Grandfathered Plants
Emissions if Plants Degrandfathered	112	18	130
Reduction from Maximum Licensed	383	72	455
Reduction from 1998 Actual Emissions	64	27	91

Note: All sulphur emission rates are tonnes per day.

6.4 Need for (Benefit of) Reduction of Sulphur Emissions

All members of the Advisory Group accept that ambient air quality objectives and provincial acid deposition loading targets, as developed by the CASA Acidifying Emission Management project team and recently adopted by AENV, are generally being met at the current time. In particular, provincial acid deposition is well below target loads, which are below critical loads. However, the Group also recognizes that there is potential for localized effects, and therefore continuous reduction should be pursued on a precautionary basis.

Further, it is recognized that some members of the public believe that sulphur emissions are adversely affecting human and animal health, and impacts the environment. In their view, it is unjust for grandfathered plants to be allowed to continue to emit more sulphur to the atmosphere than is permitted for newer plants. This has led to confrontation between industry and community residents, culminating at EUB hearings. The Advisory Group believes that decreasing sulphur emissions may lessen the concern of residents living near sour gas plants.

6.5 Cost of Degrandfathering

The Advisory Group has estimated the capital and operating costs of upgrading the grandfathered plants, for both the sulphur recovery plants and acid gas flaring plants. The current sulphur throughputs of some of these plants are significantly below approved levels, and there would be the option for these plants to meet IL 88-13 by lowering of their approved throughputs. These are included in category 1. For plants in category 2, the Advisory Group understands that commitments to upgrade have been made. Plants that would have to be upgraded to maintain current throughputs, but where the owners have not indicated any intent, are in category 3.

Estimates were made of capital costs of sulphur recovery facility upgrades and incremental operating costs, for each of the above categories. These are detailed in Appendix 1, and summarized in Table 2 : Cost of Upgrade of Sulphur Recovery Facilities. The estimates were based on 1998 data.

Table 2 : Cost of Upgrade of Sulphur Recovery Facilities

Category #	Number of Plants	Capital Cost ($ millions)	Incremental Operating Cost($ millions/ year)
Sulphur Recovery Plants			
1. Option to Relicense	15	154	14.6
2. Committed to Upgrade	6	21	1.2
3. Upgrade to Maintain 1998 Sulphur Inlet	14	153	22.0
Acid Gas Flaring Plants			
1. Option to Relicense	13	0 *	0 *
2. Committed to Upgrade	1	4 *	0.2 *
3. Upgrade to Maintain 1998 Sulphur Inlet	14	49 *	2.0 *

* These costs represent the average for a range of acid gas qualities.

The capital cost for all plants committed to upgrade and all plants that would have to upgrade to maintain throughput (categories 2 and 3) would be $227 million.

6.6 Revenues from Gas

The Advisory Group estimated the 1998 net revenues from gas processed through the grandfathered plants that were committed to upgrade or would have to upgrade to maintain throughput. This includes the plants in categories 2 and 3 in section 6.5 above. Net revenues were calculated by deducting operating costs and royalties from sales revenue.

The estimated annual net revenues from gas processed through 20 grandfathered sulphur recovery plants were in the order of $ 1 billion, and from gas through 15 acid gas flaring plants were in the order of $100 million.

6.7 Stranded Gas

The Advisory Group has analyzed the gas reserves that would ultimately remain unrecovered because of degrandfathering. This would be due to plants reaching the economic limit of operation at an earlier stage, as a result of the increased operating cost of upgraded sulphur recovery facilities. The analysis is in Appendix 2 : Stranded Gas.

It was estimated that losses would be in the range of 0.5 to 2.5 % of current connected reserves.

6.8 Acid Gas Quality

Acid gas quality is defined as the percentage of hydrogen sulphide in an acid gas stream. As the percentage of hydrogen sulphide decreases (i.e. the quality decreases), the sulphur recovery attainable by a given recovery process decreases. This effect increases with decreasing acid gas quality, and becomes most severe when the quality drops below levels of 40 % hydrogen sulphide.

The Advisory Group considered whether this should be a factor in any proposal for degrandfathering. The Group concluded that this issue should be deferred to whenever a review of the fundamentals of the sulphur recovery guidelines is undertaken. However, applications for special considerations based on acid gas quality could be allowed on an individual plant basis.

6.9 Emissions Trading / Area Pooling

The Advisory Group discussed the concept of emissions trading or area trading being a part of a degrandfathering requirement. Under such a scenario, a requirement to degrandfather a plant could be fulfilled by recovery at another plant or plants in excess of requirements.

Emissions trading mechanisms are traditionally applied on a broader regional scale. However, since the focus of degrandfathering is to reduce local effects, any trading must be between plants in close proximity, and such actions must result in comparable reductions to the same local receptors. On this basis, the Advisory Group agreed that proposals for local trading could be considered in non-routine applications.

6.10 Incentives for Higher Recoveries

The Advisory Group believes that any program for degrandfathering should include an incentive for plant operators to try to achieve recoveries higher than the required level. This is in keeping with the aim of continuous improvement.

A system is proposed to provide for the banking of credits for tonnes of sulphur from calendar quarters with higher recovery than required, and then allow subsequent restricted use of the credits in quarters when recovery falls below the requirement. Use of the credits could be restricted to no more than 0.5% per quarter, to limit deviation from the requirement. Use of banked credits would be restricted to the facility that directly earned the credit. This system would encourage efforts to maximize recoveries as a contingency for unforeseen problems, and allow for better planning of outages to correct problems.

6.11 Public Financial Assistance

Degrandfathering would advance the public policy objective of pollution prevention and would reduce the risk of localized effects. Therefore, the Advisory Group believes that some degree of public financial support would be justified if degrandfathering were implemented. The Advisory Group notes that Sulphur Emissions Control Assistance Program (SECAP) provides for royalty reductions for 50 percent of capital and operating costs of small sulphur recovery plants. A similar program could be established for degrandfathering. It could be applied to 50 percent of

the capital cost only, in order to reduce the administrative complexity and the proportion of public assistance.

It should be emphasized that the sulphur recovery upgrade cost estimates in section 6.5 above do not represent the costs that would be incurred under the Advisory Group's degrandfathering proposal described in section 7.2 below. The above estimates assume that the capacities of all plants would be upgraded to the level of 1998 sulphur inlets. Under the degrandfathering proposal, some plants would not have to upgrade at all if their throughputs remained below the 7.5 percent decline line. Others would have to upgrade only for the increment above the decline line.

7 RECOMMENDATIONS FOR DEGRANDFATHERING

7.1 Degrandfathering Alternatives

The EUB Staff discussion paper lists four possible approaches for degrandfathering:

- Sunset date
- Limits on remaining life
- Limits on increasing throughput
- Continued grandfathering, except for significant expansions

The Advisory Group believes that grandfathering should not be continued indefinitely. A sunset date alone would treat plants with declining throughputs the same as those with sustained throughputs. The Advisory Group believes that they should be treated differently. A differentiation based on remaining life is theoretically right, but practically difficult to apply. The Advisory Group therefore recommends an approach, based on limits to sulphur inlets and an ultimate sunset date, as detailed in 7.2.

7.2 Recommendations for Degrandfathering

Based on consideration of all the above factors, the Advisory Group reached agreement on the following proposal which is being put forward as a package, and the consensus support of the package is contingent upon all elements being accepted in their entirety.

All capacity above 1999 throughput levels in individual plants should be degrandfathered (i.e. subject to IL 88-13), thus capping grandfathered emissions at current levels. Further, emissions at each plant should be progressively reduced in the future. This would result from either a continuous natural decline in production supplies to the plant, or if this is not the case, from a requirement that any throughput above a specified decline be obliged to meet IL 88-13 recovery levels.

The specific terms of the grandfathering proposal are as follows:

(a) All plant capacity should be subject to IL 88-13, except for the capacity below a 7.5 % percent annual decline from the 1999 base year.

(b) The exemption limit should start to decline at year zero; the year when policy changes from the subject review are issued. However, initial compliance should not be required until after three years, at which point the accumulated decline from the start would be in effect.

(c) Any grandfathered capacity remaining after 20 years should be terminated.

(d) Credits for recovery over the required level in each calendar quarter could be banked indefinitely. The credits could be used only to a maximum of 0.5 % per quarter, and are limited to the amount needed to meet the quarterly requirement only. This credit would begin when policy changes from the subject review are issued.

(e) Royalty reductions could be claimed for fifty percent of sulphur recovery upgrade capital expenditures. Upgrade costs of capacity to 1999 base year throughput would be eligible. Grandfathered plants that have already committed to upgrade would be eligible. This program would be limited to upgrades done within 12 years.

7.3 Exemptions

As with most regulatory policies, a right to apply for exemption should be available. If degrandfathering is implemented, it is accepted that justification for exemption would have to be well founded, and potentially subject to a public hearing.

7.4 Regulatory Process

Plants owners would have two basic options, either to install upgraded sulphur recovery capability, or to reduce the approved throughput capacity to a level that complies with IL 88-13 (i.e. relicense). In either case, applications would have to be made to the EUB and AENV. Under the EUB's and AENV's normal procedures, the filing of an application opens the door to formal objection and a possible hearing about any issues concerning the subject facility, even if they are not related to degrandfathering.

The Advisory Group believes that because these applications would be made necessary by the regulators' change of rules (i.e. degrandfathering), the applications should not be subject to undue regulatory process. Short of making regulatory changes, the EUB and AENV (including the Minister) could announce support for the new policy and for expedited processing, and could restrict objections to matters directly related to degrandfathering.

7.5 Example Cases of Proposal

Example cases showing how the proposal would function are detailed in Appendix 3 : Example Cases of Degrandfathering Proposal.

8 INCENTIVES FOR HIGHER RECOVERY FOR NON-GRANDFATHERED GAS PLANTS

The incentives for higher recovery proposed above for grandfathered gas plants and in the following for heavy oil upgraders and oil refineries, should be applied universally to all facilities subject to IL 88-13.

9 OTHER UPSTREAM PETROLEUM FACILITIES

Sulphur emissions can emanate from upstream oil and gas facilities, other than gas plants. These other facilities include oil and gas batteries, pipeline compressor stations, and gas dehydration facilities. EUB Guide 60, Upstream Petroleum Industry Flaring Requirements, issued in July 1999, applied new regulations to minimize all types of flaring. This Guide states that IL 88-13 sulphur recovery requirements will apply to all facilities that process any sour non-associated gas, and will form the basis of sulphur recovery requirements for solution gas. The key aspect of IL 88-13 relating to these facilities is the requirement of sulphur recovery for sulphur volumes exceeding one tonne per day.

The Advisory Group supports the application of IL 88-13 to all other upstream oil and gas facilities. It is recommended that IL 88-13 be formally extended to apply to these other facilities.

10 INDUSTRIAL AND DOWNSTREAM PETROLEUM FACILITIES

10.1 Background

Heavy oil upgraders, oil refineries, and other industrial operations generate sour gas and acid gas streams. This results in issues of sulphur recovery similar to those for sour gas plants. Upgraders also produce coke residue which contains sulphur. The coke is used as boiler fuel, and the sulphur is carried off in the flue gas streams.

At this point, there is no formal generic regulatory policy regarding the application of the IL 88-13 Sulphur Recovery Guidelines to upgraders and refineries. However, the guidelines are being used to establish requirements for upgraders and refineries on an individual plant basis. A significant variation is that the requirements are being applied only to the sour gas and acid gas streams, and not to the flue gas streams. In this review, the EUB and AENV want to determine how the IL 88-13 Sulphur Recovery Guidelines should be applied generically to these types of facilities.

Presently in Alberta, there are two heavy oil upgraders (Syncrude's and Suncor's at Fort McMurray) and a third planned for construction (Shell's at Scotford). There are five oil refineries in Alberta (Imperial's, Petro-Canada's and Shell's in the Edmonton area, Parkland's at Bowden, and Husky's at Lloydminster). These facilities are detailed in Table 4 : Heavy Oil Upgraders and Oil Refineries in Alberta, with listing of their inlet sulphur rates, sulphur recovery levels, and status of conformance with IL 88-13. The Parkland Bowden and Husky Lloydminster refineries are not listed because they have very small levels of sulphur emissions.

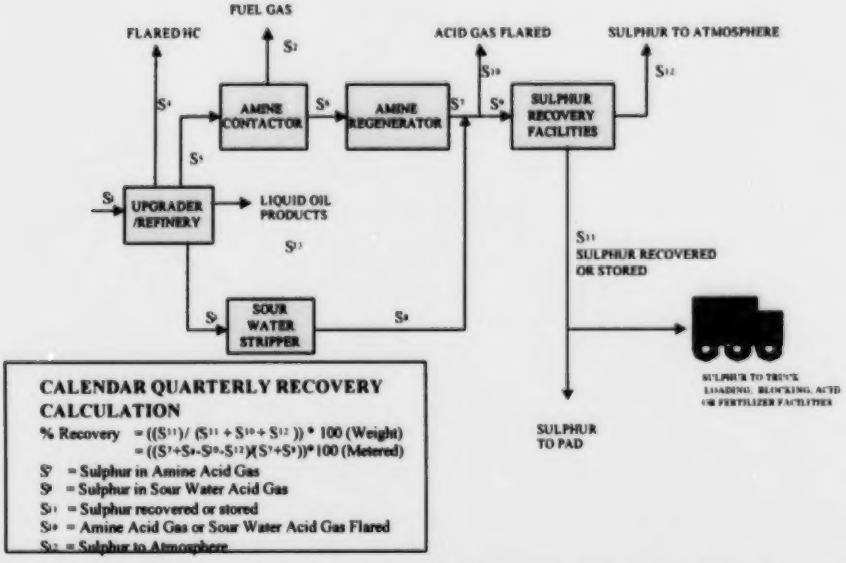
The recovery from Petro-Canada's and Shell's oil refineries currently exceed the IL 88-13 guidelines. Imperial has committed to upgrade its oil refinery by June 2003. Suncor's upgrader will meet the guideline requirements by 2002. Syncrude's upgrader and Shell's upgrader will meet the guidelines in 2004/5 (and some time allowance after start-up for commissioning) with the completion of their planned expansions.

10.2 Comparison with Gas Plants

IL 88-13 Sulphur Recovery Guidelines were developed for gas plants. Therefore, it is necessary to compare the processes and operation of upgraders and refineries, to those of gas plants, in order to assess how IL 88-13 can be appropriately applied.

Oil sands plants are large and complex operations, involving mining, bitumen separation and upgrading. As depicted in Figure 2 : Oil Sands Upgrader Sulphur Recovery Process, two principal acid gas streams originate from the upgrader unit, one that is separated in an amine unit and one from the sour water stripper. As in sour gas plants, sulphur recovery is usually accomplished with Claus units, and there may be final tail-gas clean-up units.

Figure 2 : Oil Sands Upgrader Sulphur Recovery Process



The flue gas from the coke-fired boiler contains sulphur which is emitted to the atmosphere.

Shut down of all operations in an oil sands plant for planned maintenance may only occur once every few years. It is more common for individual trains or units to shut down for maintenance. In comparison, gas plants are shut down completely when maintenance of all facilities is required.

10.3 Streams to which Requirements Apply

Sulphur recovery guidelines should apply to acid gas streams from amine units and sour water stripper units. These streams typically contain high concentrations of hydrogen sulphide. The

guidelines should apply to any flaring downstream of the amine and sour water stripper units, but should not apply to sour fuel gas.

The Advisory Group agrees that requirements for the recovery of sulphur flue gas, from sources such as thermal electrical generating plants and upgrader/refinery boilers, should be developed separately, as proposed in the EUB discussion paper.

The sulphur recovery guidelines would not be applied to Parkland's refinery and Husky's refinery because they do not have amine units or sour water stripper units.

10.4 Allowances for Upsets and Maintenance

The allowance in IL 88-13 for upsets and maintenance is a 0.3% reduction from the normal operating or design requirement, applied on a calendar quarterly average basis. In upgraders and refineries, this also covers flaring of acid gases downstream of the acid gas and sour water stripper units. The Advisory Group recommends that this basic 0.3% allowance be retained for upgraders and refineries.

The Advisory Group believes that some additional maintenance allowance should be provided for upgraders and refineries, to accommodate continued production when sulphur facilities are shut down for maintenance. Maintenance outages can range from
7 - 14 days every year, up to 40 days every five years. The allowance mechanism should provide flexibility over this range. The Advisory Group agreed on a bankable allowance of 0.15% in one quarter per year, to be used only for planned outages. The 0.15% allowance in one quarter could be used or carried forward up to a maximum of five years, or up to 0.75%.

10.5 Incentive for Higher Recovery

The Advisory Group was in agreement that some recognition should be given for recovery above required levels, under the objective of Continuous Improvement. The mechanism that has been recommended for gas plants should also be applied to upgraders and refineries. Credits for recovery in excess of requirement in a quarter can be banked indefinitely. The maximum credit that can be used in a quarter is 0.5%, and is limited to only the amount needed to meet the calendar quarterly requirement. This will provide incentive for plant operators to always maximize recovery as a contingency for unforeseen problems.

10.6 Expansions

An issue that concerns industry is the rules for expanding existing plants. The step changes in the IL 88-13 requirement levels make it difficult to justify a small incremental expansion across the step, because of the large investment that would be required to achieve higher recovery for the existing and expansion capacities. On the other hand, the EUB has demonstrated that for gas plants, it interprets IL 88-13 as requiring higher sulphur recovery levels for all gas processed by a facility when that facility applies for an increase in sulphur inlet volumes. To be fair and consistent, this policy should also be applied to upgraders and refineries.

10.7 Acid Gas Quality

As discussed above for grandfathered gas plants, decreasing acid gas quality results in a decrease in the sulphur recovery attainable. However, the Advisory Group recommends that consideration of any generic allowance for acid gas quality should be done only when a review of the fundamentals of IL 88-13 is undertaken. In the meantime, exceptions based on non-routine applications could be considered.

10.8 Agencies Having Jurisdiction

The EUB and AENV should apply the sulphur recovery guidelines consistently.

11 PLANT PROLIFERATION

11.1 Background

There is concern that proliferation of small plants may be occurring as a result of lower sulphur recovery requirements for lower plant throughput sizes. There is particular concern about incentive for sizing plants at less than one tonne per day of sulphur throughput, to avoid sulphur recovery completely.

11.2 Causes of Problem

The effect of the sulphur recovery requirement is not the only factor leading to plant proliferation. The building of other oil and gas facilities, other industrial developments, and other infrastructure developments are involved. The ultimate extent of reserve development in an area is frequently difficult to predict, and takes place over a period of time. Thus there is a tendency for new plants to be built for successive stages of development. Also there is a tendency for different owners to want to build their own plants to retain more control, to get on stream earlier, and to avoid sharing competitive data.

11.3 Existing Regulations

The EUB issued IL 91-1 Gas Processing Proliferation Policy in , and facilities application requirements in Guide G56 in 1996. These policies require applicants for new gas plants to evaluate the availability and use of existing facilities, to consider other processing needs in the area, and to consider the views of the public.

11.4 Recommendations

In the view of the members of the Advisory Group, the existing Gas Processing Proliferation Policy (IL 91-1) correctly identifies the key issues associated with public and industry concerns regarding proliferation of gas processing facilities. Furthermore, the group is of the view that many of the key elements of actions that should be taken by proponents are currently described within IL 91-1.

However, the group is also of the view that what is required is the application of a higher level of diligence by both industry proponents as well as the Board in the application of IL 91-1. In this context, the group offers the following as a supplement to IL 91-1. The two key ideas

presented here are a) requiring a higher level of due diligence by both proponents and the Board, b) establishing a decision tree that provides a framework to guide decision-making.

11.5 Strategic Objective

To make the best possible decisions regarding gas processing facilities that includes ensuring that all social, environmental, and economic factors are evaluated in a thorough, credible, and transparent manner.

The intended result of this objective is to facilitate better planning so as to optimize the orderly, efficient use and development of gas production facilities, and to minimize the overall impacts of such facilities on people and the environment.

11.6 Policy Management

The following outlines key factors for managing the Board's proliferation policy. These factors are consistent with the Board's operating principles and do not supercede any existing regulatory approval requirements or processes.

In addition to applying the following factors to individual project decisions, under circumstances where there is a high level of industry development occurring and/or significant public concerns exist, the Board may require regional operators to work collaboratively to establish a regional development plan that best coordinates these developments and responds to these concerns.

Due Diligence:

Proponent:

It is incumbent upon a proponent to have evaluated all potential processing options prior to submitting an application to the Board. The submission must include details of the evaluation of options conducted by the proponent.

In conducting its evaluation, the proponent must demonstrate that clear and appropriate opportunities have been provided for local landowners and other interested members of the community to provide input and comment on the results of the evaluation. The results of such public consultation must also be submitted with the application to the Board.

Board:

Board staff will review the evaluation conducted by the proponent for completeness and will assess the appropriateness of the option proposed by the proponent. An application will not be permitted to proceed until Board staff is satisfied that the evaluation has been properly conducted.

Decision Tree:

To provide guidance in conducting such an evaluation, the following Decision Tree outlines the framework that will guide the Board's decision-making process:

Step 1:

No new gas processing facilities will be permitted that are within a 15 * kilometer radius of an existing facility that has, or can be modified or expanded to receive the gas which the proponent is proposing to process, unless the proponent can demonstrate that significant social or environmental net benefits would result from the permitting of a new processing facility within this radius (see 2b below).

* In selecting a radius of 15 kilometers, the Advisory Group has attempted to strike a balance between encouraging Proponents to think "regionally" when assessing options for processing gas, while being sensitive to not establishing overly onerous assessment requirements for smaller developments

Step 2:

Applications to permit new processing facilities outside a 15 kilometer radius of existing facilities will be considered and evaluated by the Board according to the following criteria:

a) The proponent must clearly demonstrate that the facility is not being proposed simply to circumvent the sulphur recovery requirements of IL 88-13.

b) The proponent must clearly demonstrate that the net environmental impacts (considering air, land, and water impacts as well as risks to human and animal populations) are most effectively reduced by development of the new facility, rather than by shipping the gas to existing facilities in the region.

It is often difficult to demonstrate, on an absolute quantitative basis, the environmental superiority of one option over another. Therefore, the proponents should justify their recommendation using a combination of qualitative and quantitative considerations that collectively provide an argument that the proposed option is the best choice compared to the other options available. In evaluating each option, considerations could include:

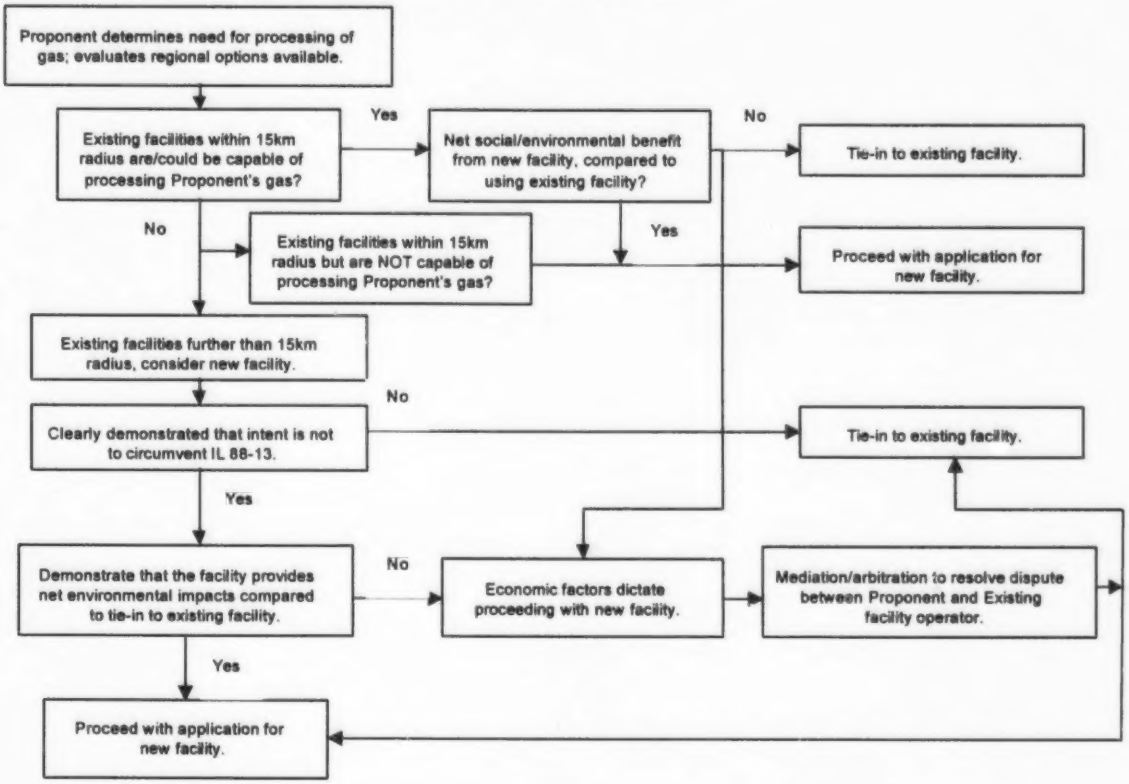
- Estimated quantity of emissions to air, estimated contribution to cumulative impacts on deposition rates, and/or ambient concentrations;
- Estimated linear disturbances, and the relative significance in terms of habitat loss, and impact on other human activities;
- Estimated impacts on local surface and groundwater bodies;
- Numbers of landowners affected;
- Views/preferences of local stakeholders regarding choices under consideration;
- Relative degrees of health and safety risk;
- Estimates of future local oil and gas development and the impacts such development may have on the viability of the options examined.

If the primary rationale for establishing a new facility, either inside or outside the 15 kilometer radius, is due to economic concerns such as processing fees, or probability of being shut-in by an existing facility which renders the shipping of gas to existing facilities uneconomic, the proponent must clearly indicate the factors that have lead to that conclusion in its application to the Board. In cases where a net social or environmental benefit from constructing the facility (as

per 2 above) cannot be demonstrated, then the Board will recommend that an arbitration mechanism be established to facilitate resolution of concerns of the operator of the existing facility.

The above mentioned decision tree is illustrated graphically below.

Figure 3: Plant Proliferation Decision Tree



12 STRUCTURE OF REGULATIONS

The Advisory Group suggests that sulphur recovery requirements for all upstream and downstream petroleum facilities in Alberta be incorporated in one guideline. There are a number of requirements that would be common to all facilities, including the fundamental recovery requirements for new plants, and the application of requirements on a calendar quarterly basis. Additional criteria could be specified to apply to certain categories of facilities.

13 APPLICATION AND ENFORCEMENT

13.1 Annual versus Calendar Quarterly Application

IL 88-13 depicts the sulphur recovery requirements for design capability and normal operations conditions. A deduction of 0.3 % from these requirements is provided to allow for normal operating upsets and maintenance, to be applied as a calendar quarterly average requirement.

In practice, the EUB has in some cases applied only the reduced quarterly requirement, whereas in other cases it has applied both an annual requirement (the design level), as a well as the quarterly requirement.

The Advisory Group recommends the application of the calendar quarterly requirement only. A calendar quarterly time period is a good balance to ensure close observance of recovery levels, but still allowing enough time to recover from upsets or planned outages.

13.2 Enforcement Procedures

The EUB applies the following enforcement procedures, which are consistent with its generic enforcement ladder of escalating consequences.

If a quarterly recovery requirement is not met, the EUB requests the plant superintendent to explain the cause and what corrective action has been taken. If requirements are not met for two quarters in a twelve-month period, the EUB meets with the senior operating personnel of the plant regarding corrective actions. In addition, the EUB gives notice that failure to meet requirements for another quarter in the next twelve-month period, will result in a reduction of the approved inlet rate or a suspension of the plant approval.

The Advisory Group supports these enforcement procedures, and emphasizes the need to apply them on a consistent and continuing basis.

14 CONCLUSION

The Advisory Group hopes that this report will assist the Alberta Energy and Utilities Board and Alberta Environment with issues regarding the application of the IL 88-13: Sulphur Recovery Guidelines and in making the guidelines more comprehensive.

Table 3 : Sulphur Recovery Guidelines Review Advisory Group Members

Members	Background and Affiliations	Residence
Environment		
Dr. Martha Kostuch	Veterinarian; Environmental Activist; Prairie Acid Rain Coalition	Rocky Mountain House
Tom Marr-Laing	Environmental Activist; Director of Energy Watch Program of the Pembina Institute	Drayton Valley
Industry		
Paul Galachiuk	Oil Sands Upgrading Process Engineer; Suncor Energy	Fort McMurray
Ian Kilgour	Natural Gas Operations and Development; Shell Canada	Calgary
Gordon Rankin	Operations and Facility Engineering; Petro-Canada	Calgary
Ron Schmitz	Environmental Engineer; Husky Oil	Calgary
Technical/Academic		
Dr. Sheldon Roth	Professor in Faculty of Medicine, Director of Environmental Research Centre; University of Calgary	Calgary
Ed Wichert	Consultant in sour gas properties, production, and processing	Calgary
Public		
Dave Brown	Cattle Rancher; Sundre Petroleum Operators Group	Caroline
Bart Guyon	Bison Rancher; Electrical and instrumentation construction and maintenance; Municipal Official	Drayton Valley
Facilitator		
Harold Keushnig	Regulatory Affairs Consultant	Calgary
Secretariat		
Fran Ziola	EUB; Regulatory Support Branch	Calgary

Table 4 : Heavy Oil Upgraders and Oil Refineries in Alberta

Refinery/Upgrader		Inlet S T/D	Process	Efficiency	IL - 88-13 Requirement	Emission S T/D
Imperial Oil – Edmonton	Now	40	2 Stage Claus	93.0%	95.9	2.8
	2003	60	?	98.5%	98.2	0.9
Shell Oil - Scotford	Now	5	2 Stage Claus	95.0%	89.7	0.25
	2005	1100	Super Claus	98.5%	98.5	16.5
Petro-Canada – Edmonton	Now	37	2 Stage Claus	96.7%	95.9	1.25
Suncor – Ft. McMurray	Now	550	3 Stage/Super Claus	98.2 to 98.3%	98.4	9.9
	2002	1200	3 Stage/Super Claus 2 Stage Claus/TGTU	98.9%	98.5	13.2
Syncrude – Ft. McMurray	Now	1600	2 Stage Claus/Sulfreen	98.2 to 98.3%	98.5	28.8
	2004	2600	2 Stage Claus/Sulfreen/FGD	99.7%	99.5	9.6
	Sulphur In - Now = 2232					Emissions, S Te/D - Now = 43.0
	Sulphur In - 2005 = 4997					Emissions, S Te/D - 2005 = 39.7

Note: Parkland Bowden Refinery and Husky Lloydminster Asphalt Refinery not included since they do not have Amine or Sour Water Stripper Units.

APPENDIX 1
COST OF DEGRANDFATHERING

GRANDFATHERED SULPHUR RECOVERY PLANTS – COSTS TO UPGRADE TO IL88-13

TABLE A : CATEGORY 1

[redacted]

Kaybob S. 3 – Chevron	Claus	78.8%	98.1%	98.4%	98.3%	1009.4	17.1
Lone Pine Ck. – Mobil	Superclaus	67.8%	98.0%	98.3%	98.1%	130.4	2.5
Edson – Talisman	Claus	45.0%	97.9%	98.3%	98.4%	100.5	1.7
Sinclair – AEC	Claus/MCRC	77.4%	97.7%	98.2%	98.2%	57.0	1.0
Medicine Lodge – Chevron	Claus	59.6%	97.0%	95.9%	97.8%	48.2	1.0
Progress – Norcen	Claus/MCRC	60.6%	96.5%	95.9%	98.5%	31.0	0.4
Zama – Pennzoil	Claus	39.7%	92.0%	95.9%	96.0%	26.1	1.0
Caroline – Amoco 1-11	Claus	26.0%	92.0%	89.7%	93.8%	8.6	0.5
Redwater - - Imperial	Claus	40.1%	0.0%	69.7%	94.4%	3.8	0.2
Windfall – Amoco	Claus/ Sulfreen	84.4%	98.3%	98.4%	98.5%	702.9	9.8
Kaybob S. 1 & @ - Amoco	Claus/ Sulfreen	50%**	98.4%	98.4%	98.5%	438.9	7.1
Crossfield – Cdn. Oxy.	Claus/ Sulfreen	63.9%	98.0%	98.4%	98.5%	429.4	6.6
Crossfield E. – Amoco	Claus/CBA	50%**	98.0%	98.4%	98.0%	413.3	8.1
Strachan – Gulf	Claus/CBA	66.9%	98.1%	98.4%	98.9%	309.1	3.5
Okotoks – Compton	Claus/CBA	80.3%	98.3%	98.3%	98.7%	262.0	3.4

[redacted]

GRANDFATHERED SULPHUR RECOVERY PLANTS – COSTS TO UPGRADE TO IL88-13

TABLE B : CATEGORY 2

Garrington (Olds) – Cdn 88	Claus	79.4%	96.5%	98.3%	96.6%	282.5	9.3	Sulfreen
Honeglen – Gulf	Claus	49.0%	92.0%	98.2%	94.8%	75.7	4.2	Sulfreen
Brazeau R. – Gulf	Claus	35.8%	92.1%	98.2%	92.8%	70.2	3.7	Sulfreen
Minnehik B. L. – Penn West	Claus	34.9%	94.5%	95.9%	96.6%	29.4	1.0	Sulfreen
Rainbow – Husky	Claus	72.0%	95.0%	98.2%	96.4%	64.7	2.2	Sulfreen
Nordegg – Gulf	Claus	42.1%	93.5%	95.9%	94.4%	30.3	2.0	Sulfreen

GRANDFATHERED SULPHUR RECOVERY PLANTS – COSTS TO UPGRADE TO IL88-13

TABLE A : CATEGORY 1

Field-Operator	Sulphur Recovery Technology	S-20/30 1997 Acid Gas Quality (%)	Current Required Sulphur Recovery Efficiency (%)	Quarterly IL 88-13 Requirement	1997 Sulphur Recovery Efficiency	1997 Inlet S (t/d)	1997 Incin + Flared S (t/d)	Required Upgrade	IL 88-13 Incremental Recovery	Incremental Upgrade Recovery (tonnes S/d)	Upgrade Capital Cost (1999 MM$)	Upgrade Incremental Op Cost (1999 K$/yr)	1998 Gas Revenues (MM$)
Category 1 – Option to Delicense													
Kaybob S 3 – Chevron	Claus	78.8%	98.1%	98.4%	98.3%	1009.4	17.1						
Lone Pine Ck – Mobil	Superclaus	67.8%	98.0%	98.3%	98.1%	130.4	2.8						
Edson – Talisman	Claus	45.0%	97.9%	98.3%	98.4%	100.5	1.7						
Sinclair – AEC	Claus MCRC	72.4%	97.7%	98.2%	98.2%	57.0	1.0						
Medicine Lodge – Chevron	Claus	59.6%	97.0%	95.9%	97.8%	48.2	1.0						
Progress – Norcen	Claus MCRC	60.6%	96.5%	95.9%	98.5%	31.0	0.4						
Zama – Pennzoil	Claus	39.7%	92.0%	95.9%	96.0%	26.1	1.0						
Caroline – Amoco I, II	Claus	26.0%	92.0%	89.7%	93.8%	8.6	0.5						
Redwater – Imperial	Claus	40.1%	0.0%	69.7%	94.4%	3.8	0.2						
Windfall – Amoco	Claus-Sulfreen	84.4%	98.3%	98.4%	98.5%	702.9	9.8						
Kaybob S 1,A, 2 – Amoco	Claus-Sulfreen	50%**	98.4%	98.4%	98.5%	438.9	7.1						
Crossfield – Cdn Occ	Claus-Sulfreen	63.9%	98.0%	98.4%	98.5%	429.4	6.6						
Crossfield E – Amoco	Claus CBA	50%**	98.0%	98.4%	98.0%	413.3	8.1						
Strachan – Gulf	Claus CBA	66.9%	98.1%	98.4%	98.9%	369.1	3.5						
Okotoks – Compton	Claus CBA	80.3%	98.3%	98.3%	98.7%	262.0	3.4						
Subtotal – Option to Delicense						**3970**	**64**						

GRANDFATHERED SULPHUR RECOVERY PLANTS – COSTS TO UPGRADE TO IL88-13

TABLE B : CATEGORY 2

Field-Operator	Sulphur Recovery Technology	S-20/30 1997 Acid Gas Quality (%)	Current Required Sulphur Recovery Efficiency (%)	Quarterly IL 88-13 Requirement	1997 Sulphur Recovery Efficiency	1997 Inlet S (t/d)	1997 Incin + Flared S (t/d)	Required Upgrade	IL 88-13 Incremental Recovery	Incremental Upgrade Recovery (tonnes S/d)	Upgrade Capital Cost (1999 MMS)	Upgrade Incremental Op Cost (1999 K$/yr)	1998 Gas Revenues (MMS)
Category 2 – Committed to Upgrade													
Garrington (Olds) – Cdn 88	Claus	79.4%	96.5%	98.5%	96.6%	282.5	9.3	Sulfreen					
Homeglen – Gulf	Claus	49.0%	92.0%	98.2%	94.8%	75.7	4.2	Sulfreen					
Brazeau R – Gulf	Claus	55.8%	92.1%	98.2%	92.8%	70.2	5.7	Sulfreen					
Minnehik B-1 – Penn West	Claus	64.9%	94.5%	98.0%	96.6%	29.4	1.0	Sulfreen					
Rainbow – Husky	Claus	72.0%	95.0%	98.2%	96.4%	64.7	2.2	Sulfreen					
Nordegg – Gulf	Claus	42.1%	93.5%	98.0%	94.4%	30.3	2.0	Sulfreen					
Subtotal – Committed to Upgrade						**553**	**22**		**13**	**16**	**21**	**1197**	**355**

GRANDFATHERED SULPHUR RECOVERY PLANTS – COSTS TO UPGRADE TO IL88-13

TABLE C : CATEGORY 3

Field-Operator	Sulphur Recovery Technology	S-20/30 1997 Acid Gas Quality (%)	Current Required Sulphur Recovery Efficiency (%)	Quarterly IL 88-13 Requirement	1997 Sulphur Recovery Efficiency	1997 Inlet S (t/d)	1997 Incin + Flared S (t/d)	Required Upgrade	IL 88-13 Incremental Recovery	Incremental Upgrade Recovery (tonnes S/d)	Upgrade Capital Cost (1999 MM$)	Upgrade Incremental Op Cost (1999 K$/yr)	1998 Gas Revenues (MM$)
Category 3 – Upgrade to Maintain Current Throughput													
Caroline – Amoco 4-20	Claus	14.1%	85.0%	89.7%	87.3%	7.2	0.9	Sulfreen					
Carstairs – Home	Claus	8.5%	90.0%	95.9%	93.2%	13.1	0.9	Sulfreen					
Teepee – Talisman	Claus	56.1%	92.0%	95.9%	95.4%	16.3	0.8	Sulfreen					
Sturgeon Lk – Poco	Claus	61.3%	94.0%	95.9%	94.8%	29.5	2.1	Sulfreen					
Rosevear – Suncor	Claus	49.8%	94.6%	98.2%	95.8%	45.7	2.1	Sulfreen					
Gold Creek – Rio Alto	Claus	50%**	97.0%	98.2%	97.9%	54.8	1.2	Sulfreen					
Simonette – Suncor	Claus	78.2%	96.5%	98.2%	97.2%	67.5	1.8	Sulfreen					
Rosevear – Suncor	Claus	56.5%	95.6%	98.3%	97.0%	90.2	2.8	Sulfreen					
Wildcat Hills – Petro-Canada	Claus MCRC	45.5%	97.5%	98.3%	98.1%	126.3	2.4	Sulfreen					
Wimborne – Ulster	Claus	90.3%	94.5%	98.3%	96.8%	151.4	4.9	Sulfreen					
Burnt Timber – Shell	Superclaus	65.8%	96.5%	98.4%	97.3%	384.5	10.3	Sulfreen					
Jumping Pound – Shell	Claus	52.3%	96.2%	98.4%	96.8%	438.0	14.1	Sulfreen					
Waterton – Shell	Claus SCOT	73.5%	98.7%	99.5%	98.9%	1991.8	24.0	SCOT					
Strachan – Husky	Claus Sulfreen	66.1%	98.1%	99.5%	98.8%	2225.6	22.5	SCOT					
Subtotal – Option to Upgrade						**5642**	**96**		**46**	**69**	**153**	**22014**	**651**

TABLE D – GRANDFATHERED ACID GAS FLARING PLANTS
COSTS TO UPGRADE TO IL 88-13

Field	Approved Sulphur Inlet (t/d)	Actual Average 1998 Sulphur Inlet (t/d)	Capital (MM$)	Total Op Cost (K$/yr)	Total 1998 Gas Revenues (MM$)
Category 1 – Option to Delicense					
Bittern Lake – CNRL	2.48	0.81			
Boundary Lake South – Pioneer	2.20	0.77			
Boundary Lake South – Rigel	1.90	0.70			
Little Bow – Crestar	1.60	0.70			
Ansell – Ranger	1.30	0.69			
Leduc-Woodbend – Imperial	1.01	0.65			
Spirit River – Norcen	2.60	0.62			
Bantry – Beau Canada	1.00	0.62			
Carson Creek – Mobil	1.00	0.50			
Sylvan Lake – Ocelot	1.85	0.43			
Big Bend – CNRL	1.50	0.41			
Enchant – ANG	1.25	0.30			
Harmattan-Elkton – Home	1.66	0.27			
Subtotal – Option to Delicense	**21**	**8**	**0**	**0**	
Category 2 – Committed to Upgrade					
Wilson Creek – Petro-Can	7.60	4.01			
Subtotal – Committed to Upgrade	**8**	**4**	**3 to 5**	**123 to 218**	
Category 3 – Upgrade to Maintain Current Throughput					
Virginia Hills – Shell	9.80	8.67			
Judy Creek – Pengrowth	7.60	3.78			
Forestburg – Signalta	4.50	3.30			
Greencourt- CNRL	5.08	2.92			
Whitecourt – Petro-Can	7.50	2.70			
Killam – AltaGas	4.80	2.70			
Bellshill Lake – Petro-Can	3.25	2.70			
Vulcan – Crestar	3.00	1.93			
Strome – Sceptre	3.40	1.72			
Bigoray – Amoco	2.90	1.60			
Kaybob – Petro-Can	5.15	1.58			
West Drumheller – Vintage	2.09	1.33			
Wilson Creek – Imperial	1.68	1.16			
Retlaw – Northstar	1.92	1.02			
Subtotal – Option to Upgrade	**61**	**34**	**39 to 58**	**1519 to 2524**	**99.6**
Subtotal – Committed & Option to Upgrade	**69**	**38**	**42 to 63**	**1642 to 2742**	
TOTAL	**90**	**45**	**42 to 63**	**1642 to 2742**	

GRANDFATHERED SULPHUR RECOVERY PLANTS – COSTS TO UPGRADE TO IL88-13

TABLE C : CATEGORY 3

[redacted]

Caroline – Amoco 4-20	Claus	14.1%	85.0%	89.7%	87.3%	7.2	0.9	Sulfreen
Carstairs – Home	Claus	8.5%	90.0%	95.9%	93.2%	13.1	0.9	Sulfreen
Teepee – Talisman	Claus	56.1%	92.0%	95.9%	95.4%	16.3	0.8	Sulfreen
Sturgeon Lk. – Poco	Claus	61.3%	94.0%	95.9%	94.8%	29.5	2.1	Sulfreen
Rosevear – Suncor	Claus	49.8%	94.6%	98.2%	95.8%	45.7	2.1	Sulfreen
Gold Creek – Rio Alto	Claus	50%**	97.0%	98.2%	97.9%	54.8	1.2	Sulfreen
Simonette – Suncor	Claus	78.2%	96.5%	98.2%	97.2%	67.5	1.8	Sulfreen
Rosevear – Suncor	Claus	56.5%	95.6%	98.3%	97.0%	90.2	2.8	Sulfreen
Wildcat Hills – Petro-Canada	Claus/MCRC	45.5%	97.5%	98.3%	98.1%	126.3	2.4	Sulfreen
Wimborne – Ulster	Claus	90.3%	94.5%	98.3%	96.8%	151.4	4.9	Sulfreen
Burnt Timber – Shell	Superclaus	65.8%	96.5%	98.4%	97.3%	384.5	10.3	Sulfreen
Jumping Pound – Shell	Claus	52.3%	96.2%	98.4%	96.8%	438.0	14.4	Sulfreen
Waterton – Shell	Claus/SCOT	73.5%	98.7%	99.5%	98.9%	1991.8	24.0	SCOT
Strachan – Husky	Claus/ Sulfreen	66.1%	98.1%	99.5%	98.8%	2225.6	27.5	SCOT

[redacted]

TABLE D – GRANDFATHERED ACID GAS FLARING PLANTS
COSTS TO UPGRADE TO IL 88-13

Bittern Lake – CNRL	2.48	0.81			
Boundary Lake South – Pioneer	2.20	0.77			
Boundary Lake South – Rigel	1.90	0.70			
Little Bow –Crestar	1.60	0.70			
Ansell – Ranger	1.40	0.69			
Leduc-Woodbend – Imperial	1.01	0.63			
Spirit River – Norcen	2.60	0.62			
Bantry – Beau Canada	1.00	0.62			
Carson Creek – Mobil	1.00	0.59			
Sylvan Lake – Ocelot	1.85	0.43			
Big Bend – CNRL	1.50	0.41			
Enchant – ANG	1.25	0.39			
Harmattan-Elkton – Home	1.66	0.37			
Wilson Creek – Petro-Can	7.60	4.01			
Virginia Hills – Shell	9.80	5.67			
Judy Creek – Pengrowth	3.60	3.78			
Forestburg – Signalta	4.50	3.39			
Greencourt- CNRL	5.08	2.92			
Whitecourt – Petro-Can	7.50	2.79			
Killam – AltaGas	4.80	2.70			
Bellshill Lake – Petro-Can	3.15	2.10			
Vulcan – Crestar	4.90	1.93			
Strome – Sceptre	3.40	1.77			
Bigoray – Amoco	2.96	1.60			
Kaybob – Petro-Can	5.15	1.58			
West Drumheller – Vintage	2.99	1.33			
Wilson Creek – Imperial	1.68	1.16			
Retlaw – Northstar	1.92	1.02			

ASSUMPTIONS USED TO GENERATE THE CAPITAL AND OPERATING COST ESTIMATES

A number of assumptions were made in the process of estimating the capital and operating costs of upgrading sulphur recovery at grandfathered sulphur recovery plants and grandfathered acid gas flaring plants. These assumptions are described below.

Sulphur Recovery Plants

Sulphur recovery plants are plants that remove the sulphur from the sour natural gas and then recover it either as elemental sulphur (most common), or as some other byproduct which incorporates the sulphur. The sulphur recovery ability of individual plants is a function of a number of factors including the technology employed, the acid gas quality, the plant inlet rate, etc. In order to estimate the capital and operating costs involved in upgrading grandfathered sulphur recovery plants, the following assumptions were made:

a) the plants can be divided into three categories, i.e. plants which could delicense to current inlet rates and meet IL 88-13 at those rates, plants which have already given some indication (based on discussions within the Advisory Group) that they are planning to upgrade their recovery levels, and plants which would need to upgrade if they wish to meet IL 88-13 requirements at their current inlet rates but have not yet indicated any plans to do so,

b) the plants would design to meet IL 88-13 requirements at their current inlet rates (as opposed to their licensed inlet rates) and current acid gas quality conditions,

c) although there are a wide variety of possible technologies available to upgrade sulphur recovery at these plants, for the purpose of simplification, only two upgrade technologies were considered, i.e. Sulfreen and SCOT tail gas cleanup,

d) for plants where acid gas quality information was not available a value of 50% was used for estimation purposes. These cases are noted with two asterisks beside the acid gas quality figure.

e) Since acid gas quality information was not readily available for 1998, 1997 data was used to do the cost estimates shown.

Acid Gas Flaring Plants

Acid gas flaring plants are plants that have incorporated some type of technology to remove the sulphur from the sour natural gas and then, rather than recovering the sulphur in some fashion, the acid gas is flared. The following assumptions were used in estimating the capital and operating costs of upgrading the grandfathered acid gas flaring plants to meet IL 88 –13:

a) no upgrades would be performed on acid gas flaring plants with existing (versus licensed) inlet sulphur rates below 1 tonne of sulphur per day since they would have the option of simply delicensing to be exempt from IL 88-13,

b) for those plants covered by IL 88-13, acid gas injection would be the technology of choice to meet the sulphur recovery requirements,

c) suitable conditions exist at the acid gas flaring plants for the application of acid gas technology, i.e. there is a suitable disposal formation available, there would be public acceptance of the proposal, etc. (This may not be an appropriate assumption for some cases); and

d) acid gas quality data was not available for these plants so calculations were done for 15% acid gas quality and for 85% acid gas quality to cover a reasonable range of operating conditions. Capital and operating cost estimates have therefore been shown as a range.

APPENDIX 2
STRANDED GAS

IMPACT OF GAS PLANT DEGRANDFATHERING PROPOSAL ON STRANDED RESERVES

Overview

One of the specific issues the advisory panel was asked to consider was the impact of this degrandfathering proposal on reserves recovery. There is a concern that the increased capital and operating costs associated with IL88-13 compliance would reduce gas plant economic life and thereby strand reserves that could otherwise be recovered under a lower cost environment.

Application of IL88-13 guidelines indiscriminately to grandfathered facilities based on their current operating production has the potential to strand reserves in plants in declining fields. However, the analysis indicates that the Advisory Group's degrandfathering proposal would not be expected to have significant impact on stranding those reserves currently associated with the grandfathered facilities. Future reserve discoveries may be somewhat affected by plants having higher operating costs but this impact is expected to be minimal and manageable within the gas plant's operating budgets. For these new reserves, increased recovery costs are just one of many incremental costs associated with new gas reserve development, all of which are considered in determining ultimate reserves recovery and go-forward project viability.

The reserves impact analysis was based mainly on the larger grandfathered plants currently having sulphur recovery capabilities as they were expected to have the larger cost impacts with degrandfathering. The impact on acid gas flaring plants was not specifically analyzed but it is expected that many of the conclusions reached will be relevant to these plants as well. Although smaller in size than upgrades on the larger facilities, upgrades on acid gas flaring facilities can be a significant percentage increase in capital and operating costs and thereby impact reserves recovery for those facilities.

The following discusses in more detail the impact on reserves recovery of the Advisory Group's proposal.

Capital Impact

As outlined in the industry analysis of IL88-13 compliance costs, there is significant capital cost impact associated with immediate degrandfathering of gas plants to IL88-13 standards. The proposal presented in this document significantly reduces the capital expenditure impact of degrandfathering and any associated plant closures which could lead to potential stranding of reserves.

Plants nearing end of life for which the remaining cashflow is too low to support a large capital expenditure are most susceptible to stranding of reserves from forced capital expenditure. The emissions banking and declining base features of the current proposal provide relief for these declining plants and enable economic recovery of reserves similar to that expected under current grandfathered licenses. Those plants capable of maintaining their throughput above the 7.5% declining base through reserves addition likely have a business case for any upgrade capital required and therefore should not have their existing connected reserves recoveries affected by the capital requirement to meet IL88-13.

Operating Cost Impact

Incremental operating costs associated with IL88-13 upgrades, although smaller than initial upgrade capital, have significant potential to strand reserves in older plants. As a plant cannot economically operate beyond the point where it becomes cashflow negative, any significant increase in unit operating costs as a result of increased sulphur recovery requirements, will result in premature plant shutdown (see attached Figure 1)

To quantify precisely the effect of increased operating costs on reserve recovery is difficult, as the ultimate impact will depend on each specific plant's configuration and remaining production profile over life. However, reserves recovery impact can be qualitatively assessed through a more generic review.

Cashflow modeling was done for 2 different production profiles; one reflecting a shorter, 10 year production profile and the other a longer, 20 year production profile. The shorter profile case is more typical of those plants near end of life with rapidly declining plant production and no significant reserves additions foreseen in the future. The longer life profile represents plants with significant remaining life and lower decline rate due to additional connected reserves.

The impact of increased operating costs on stranded reserves is shown in Figure 2 for these 2 production scenarios. While Figure 2 shows the potential losses associated with upgrading sulphur recovery, can in principle be large, the actual stranding of current reserves associated with this degrandfathering proposal is expected to be minimal for several reasons.

Many of the grandfathered plants will have production declines which are steeper than the 7.5% base decline rate and therefore will not be exposed to the incremental operating costs associated with upgrades over their economic life. Of the plants that will require upgrades, the majority can utilize enhanced sulphur plant processes to meet licence requirements. These processes have relatively low operating costs (0 to 5% incremental operating costs) resulting in little impact on reserves recovery, between 0.5 and 2.5% (see Figure 2)

The larger plants requiring the addition of full tailgas cleanup units will see a more significant increase in operating costs (up to 30% incremental costs). However, these plants are typically of the longer life profile and therefore are not expected to have significant stranded reserves associated with this production, less than 2% (see Figure 2). If these larger plants remain at higher production levels through processing additional reserves, these additional reserves will extend the plant life and further reduce stranded reserves for the facilities.

Figure 1
Relationship Between Operating Costs and Reserves Recovery

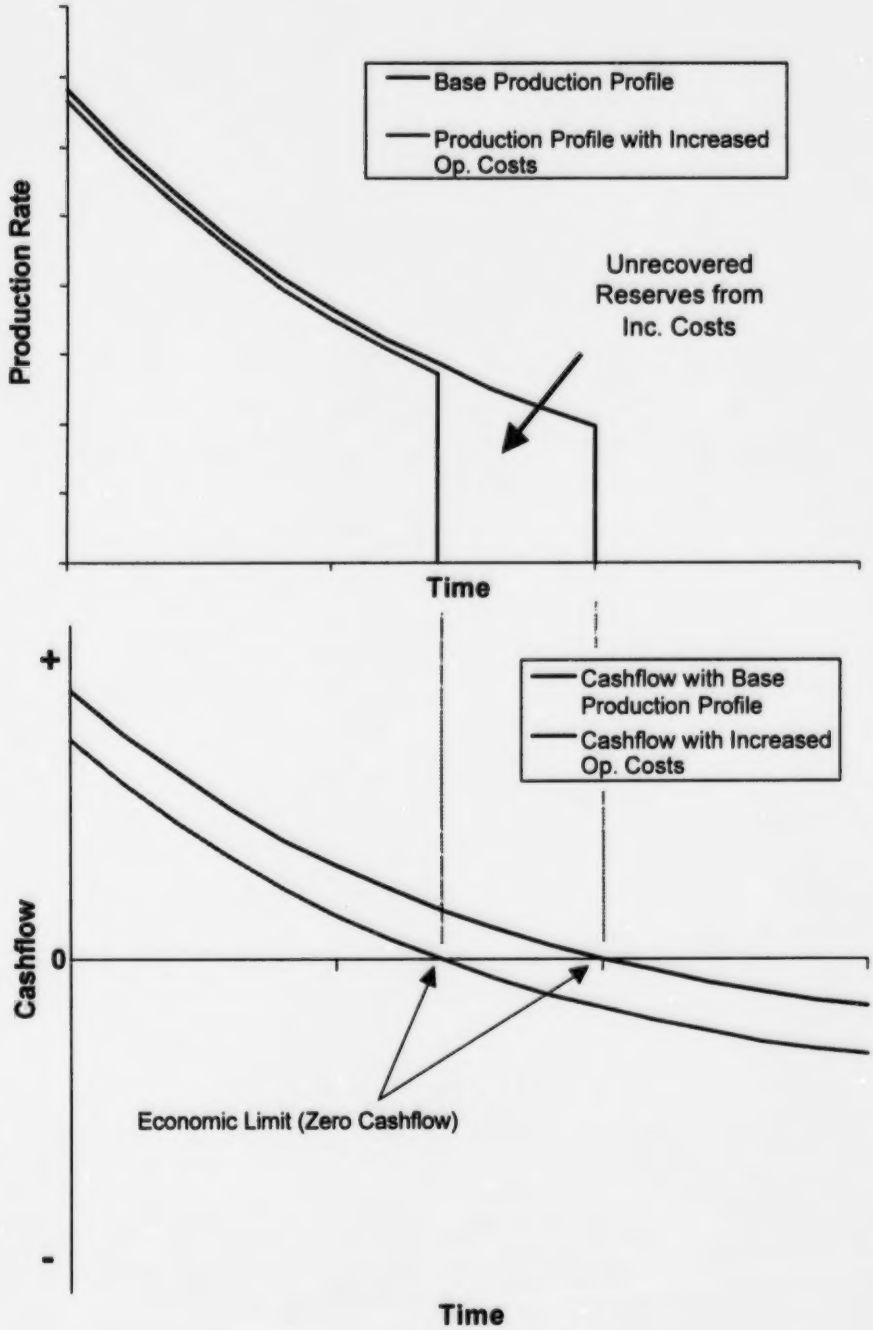
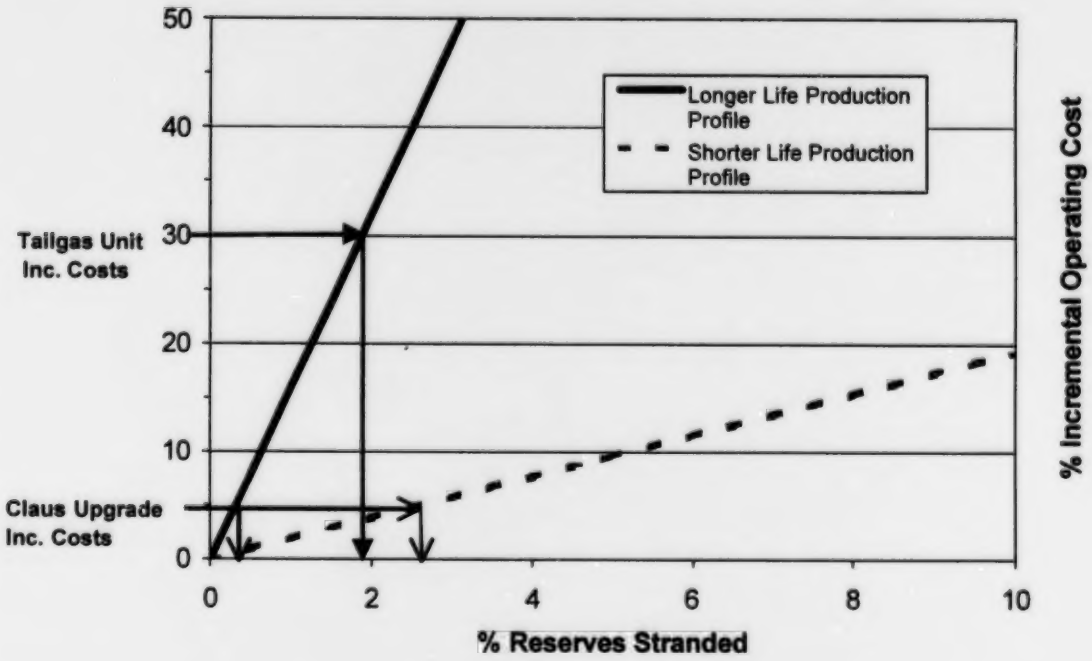


Figure 2
Impact of Incremental Operating Costs on Stranded Reserves



APPENDIX 3
EXAMPLE CASES OF DEGRANDFATHERING PROPOSAL

Figure B : Degrandfathering Proposal

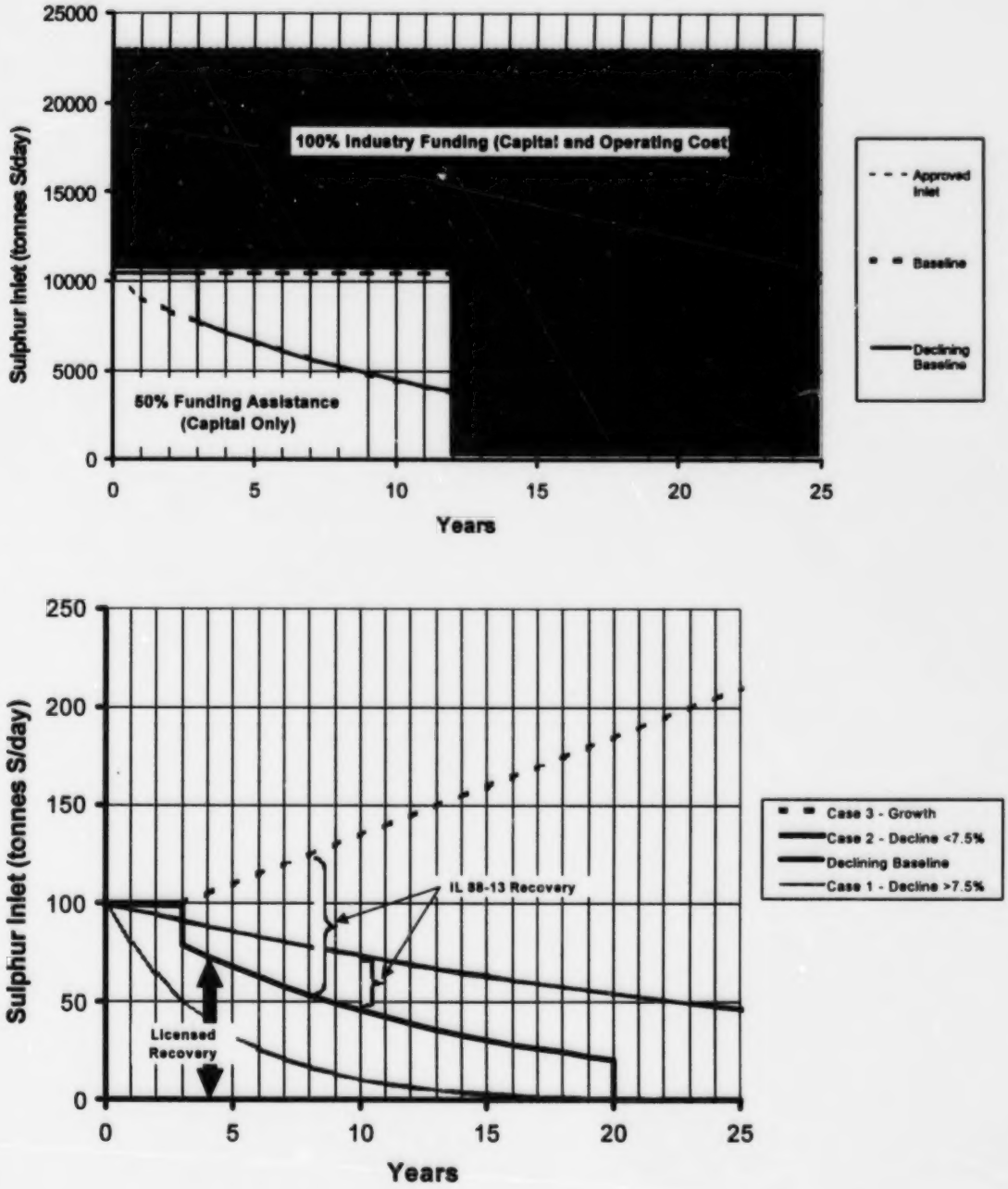


Figure B : Calculation of Blended Recovery Requirements

1999 Baseline = 100 tonnes S/d

Current Licensed Quarterly Sulphur Recovery Requirement = 95%

Case 1 - Inlet sulphur decline rate > 7.5% per annum

Case 2 - Inlet sulphur decline rate < 7.5% per annum

Case 3 - Inlet sulphur growth

Year	Declining Base With 3 Year Grace Period (tonnes S/d)	Case 1 Actual Inlet (tonnes S/d)	Case 1 IL 88-13 Quarterly Requirement at Actual Inlet	Case 1 Blended Quarterly Recovery Requirement	Case 2 Actual Inlet (tonnes S/d)	Case 2 IL 88-13 Quarterly Requirement at Actual Inlet	Case 2 Blended Quarterly Recovery Requirement	Case 3 Actual Inlet (tonnes S/d)	Case 3 IL 88-13 Quarterly Requirement at Actual Inlet	Case 3 Blended Quarterly Recovery Requirement
1	100.0	80.0	N/A	95.00%	97.0	N/A	95.00%	100.0	N/A	95.00%
2	100.0	64.0	N/A	95.00%	94.1	N/A	95.00%	100.0	N/A	95.00%
3	100.0	51.2	N/A	95.00%	91.3	N/A	95.00%	100.0	N/A	95.00%
4	73.2	41.0	95.90%	95.00%	88.5	98.25%	95.56%	105.0	98.26%	95.99%
5	67.7	32.8	95.90%	95.00%	85.9	98.24%	95.69%	110.0	98.26%	96.25%
6	62.6	26.2	95.90%	95.00%	83.3	98.24%	95.80%	115.0	98.27%	96.49%
7	57.9	21.0	95.90%	95.00%	80.8	98.24%	95.92%	120.0	98.27%	96.69%
8	53.6	16.8	95.90%	95.00%	78.4	98.24%	96.02%	125.0	98.27%	96.87%
9	49.6	13.4	95.90%	95.00%	76.0	98.23%	96.13%	130.0	98.28%	97.03%
10	45.9	10.7	95.90%	95.00%	73.7	98.23%	96.22%	135.0	98.28%	97.17%
11	42.4	8.6	89.70%	95.00%	71.5	98.23%	96.31%	140.0	98.28%	97.29%
12	39.2	6.9	89.70%	95.00%	69.4	98.23%	96.40%	145.0	98.29%	97.40%
13	36.3	5.5	89.70%	95.00%	67.3	98.22%	96.49%	150.0	98.29%	97.49%
14	33.6	4.4	89.70%	95.00%	65.3	98.22%	96.56%	155.0	98.29%	97.58%
15	31.1	3.5	89.70%	89.70%	63.3	98.22%	96.64%	160.0	98.29%	97.66%
16	28.7	2.8	89.70%	89.70%	61.4	98.22%	96.71%	165.0	98.30%	97.72%
17	26.6	2.3	89.70%	89.70%	59.6	98.21%	96.78%	170.0	98.30%	97.78%
18	24.6	1.8	89.70%	89.70%	57.8	98.21%	96.85%	175.0	98.30%	97.84%
19	22.7	1.4	89.70%	89.70%	56.1	98.21%	96.91%	180.0	98.30%	97.89%
20	21.0	1.2	89.70%	89.70%	54.4	98.21%	96.97%	185.0	98.31%	97.93%
21	0.0	0.7	N/A	N/A	52.7	98.20%	98.20%	190.0	98.31%	98.31%
22	0.0	0.6	N/A	N/A	51.2	98.20%	98.20%	195.0	98.31%	98.31%
23	0.0	0.5	N/A	N/A	49.6	95.90%	95.90%	200.0	98.31%	98.31%
24	0.0	0.4	N/A	N/A	48.1	95.90%	95.90%	205.0	98.31%	98.31%
25	0.0	0.3	N/A	N/A	46.7	95.90%	95.90%	210.0	98.32%	98.32%

Figure B : Calculation of Blended Recovery Requirements

1999 Baseline = 100 tonnes S/d

Current Licensed Quarterly Sulphur Recovery Requirement = 95%

Case 1 - Inlet sulphur decline rate > 7.5% per annum

Case 2 - Inlet sulphur decline rate < 7.5% per annum

Case 3 - Inlet sulphur growth

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